Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus

Bachelor of Science (Geology)

Submitted by

Board of Studies,

Bachelor of Science (Geology)

FYUGP-Scheme I-VIII Semester

Bachelor of Science (Honors/Research)

(Geology - Major)

Four Year (Eight Semester Degree Course)

Teaching and Examination Scheme

B.Sc. Sem-I (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Introduction to Geology	BGE1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Introduction to Geology	BGE1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Rock Forming Minerals	BGE1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Rock Forming Minerals	BGE1P02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Geological Mapping Techniques	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**	**-**	**530**	**170**	**-**	**125**	**275**	**-**

B.Sc. Sem-II (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Physical Geology and General Geology	BGE2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Physical Geology and General Geology	BGE2P03	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Optical Mineralogy and Crystallography	BGE2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Optical Mineralogy and Crystallography	BGE2P04	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Evaluation to Landforms	BVS2P03	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	-	-	-	50	50	50
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**	**-**	**530**	**170**	**-**	**125**	**275**	**-**

Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-III (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Igneous Rocks	BGE3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Igneous Rocks	BGE3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Sedimentary Rocks	BGE3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Sedimentary Rocks	BGE3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

B.Sc. Sem-IV (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Metamorphic Rocks	BGE4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Metamorphic Rocks	BGE4P07			2	1	-	-	-	-	25	25	25
3	DSC	Palaeontology	BGE4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Palaeontology	BGE4P08			2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)				2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-		2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)				2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	SEC	Refer SEC Basket	BVS4T06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	English Compulsory	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-V (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min.
1	DSC	Structural Geology	BGE5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Structural Geology	BGE5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Economic Geology	BGE5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Economic Geology	BGE5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Indian Stratigraphy	BGE5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Indian Stratigraphy	BGE5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 1	BIT5T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 1	BIT5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
13	VSC	Refer VSC Basket	BVS5P07	-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service	BCM5P02	-	-	2	1	-	-	-	-	25	25	25
Total				**13**	**-**	**18**	**22**	**-**	**520**	**130**	**--**	**150**	**300**	**-**

B.Sc. Sem-VI (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Remote Sensing	BGE6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Remote Sensing	BGE6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Hydrogeology	BGE6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Hydrogeology	BGE6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Geomorphology	BGE6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Geomorphology	BGE6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 2	BIT6T16	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 2	BIT6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	VSC	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
12	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	**22**		**440**	**110**		**225**	**325**	

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

B.Sc. Sem-VII (Honors) (Geology - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Mineralogy	BGE7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Mineralogy	BGE7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Igneous Petrology	BGE7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Igneous Petrology	BGE7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Metamorphic Petrology	BGE7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Metamorphic Petrology	BGE7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Sedimentary Petrology	BGE7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Sedimentary Petrology	BGE7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3	BIT7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 3	BIT7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BIT7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BIT7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	**20**		**520**	**130**		**125**	**225**	

B.Sc. Sem-VIII (Honors) (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Principles of Stratigraphy	BGE8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Principles of Stratigraphy	BGE8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Introduction to Geochemistry	BGE8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Introduction to Geochemistry	BGE8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Paleoclimates and Quaternary Geology	BGE8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Paleoclimates and Quaternary Geology	BGE8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Introduction to Micropaleontology and Mineral Exploration	BGE8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Introduction to Micropaleontology and Mineral Exploration	BGE8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4	BIT8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 4	BIT8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

Four Year UG Honours Degree in Major and Minor with 160-176 credits

B.Sc. Sem-VII (Research) (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Igneous Petrology	BGE7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Igneous Petrology	BGE7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Metamorphic Petrology	BGE7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Metamorphic Petrology	BGE7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Sedimentary Petrology	BGE7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Sedimentary Petrology	BGE7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3	BGE7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 3	BGE7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BIT7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BIT7P21R	-	-	4	2	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

'R' in the subject code indicates 'Research'.

B.Sc. Sem-VIII (Research) (Geology - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Principles of Stratigraphy	BGE8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Principles of Stratigraphy	BGE8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Introduction to Geochemistry	BGE8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Introduction to Geochemistry	BGE8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Instrumentation Techniques, Geostatistics and Computer application in Geology	BGE8T24R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Instrumentation Techniques, Geostatistics and Computer application in Geology	BGE8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 4	BIT8T25R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 4	BIT8P25R	-	-	2	1	-	-	-	-	-	50	25
9	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2 +1)	-	-	-	-	175	175	175
Total				09	-	22	**20**		**360**	**90**		**225**	**325**	

'R' in the subject code indicates 'Research'.

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

ABBREVIATIONS: Generic/Open Electives: **OE**, Vocational Skills & Skill Enhancement Courses: **VSEC**, Vocational Skill Courses: **VSC**, Skill Enhancement Courses: **SEC**, Ability Enhancement Courses: **AEC**, Indian Knowledge Systems: **IKS**, Value Education Courses: **VEC**, On Job Training (Internship/Apprenticeship): **OJT**, Field Project: **FP**, Community Engagement & Service: **CEP**, Co-curricular Courses: **CC**, Research Methodology: **RM**, Research Project: **RP**

VSC Basket (Geology)

Semester	Course Category	Name of Course	BoS	Course Code
I	**VSC**	Geological Mapping Techniques	Geology	**BVS1P01**
II	**VSC**	Evaluation to Landforms	Geology	**BVS2P03**
III	**VSC**	Remote Sensing Data Acquisition and Application	Geology	**BVS3P05**
V	**VSC**	Understanding of Geohazards	Geology	**BVS5P07**
VI	**VSC**	Artificial Recharge of Groundwater	Geology	**BVS6P08**

Basket for ELECTIVE (DSE) Category Courses (Geology)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Introduction to Earth's Geological History	BGE5T12
		B. Introduction to Geodynamics and Tectonics	
VI	Elective 2	A. Introduction to Paleoclimates	BGE6T16
		B. Introduction to Watershed Management	
VII (Honors)	Elective 3	A. Introduction to Quaternary Geology	BGE7T21
		B. Introduction to Micropaleontology	
VIII (Honors)	Elective 4	A. Introduction to Mineral Exploration	BGE8T27
		B. Introduction to Environmental Geology and Geohazards	
VII (Research)	Elective 3	A. Introduction to Quaternary Geology	BGE7T20R
		B. Introduction to Micropaleontology	
VIII (Research)	Elective 4	A. Introduction to Mineral Exploration	BGE7T25R
		B. Introduction to Environmental Geology and Geohazards	

B.Sc. Geology Syllabus (CBCS) Revised in 2023-24 (DSC)

Program Outcomes (POs) for B. Sc. Programme

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Problem Solving: Solve problems from the disciplines of concern using the knowledge, skills and attitudes acquired from sciences/ mathematics/ social sciences/ humanities.

PO3. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO4. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in wide variety of settings.

PO5. Ethics: Understand multiple value systems including your own, the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and sustainability: Understand the impact of technology and business practices in societal and environmental contexts, and sustainable development.

PO7. Self-directed and life-long learning: Demonstrate the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PO8. Design/Development of Solutions: Design solutions for complex science problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO9. Computational Thinking: Understand data-based reasoning through translation of data into abstract concepts using computing technology-based tools.

PO10. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO11. Global Perspective: Understand the economic, social and ecological connections that link the world's nations and people.

PO12. Aesthetic Engagement: Demonstrate and master the ability to engage with the arts and draw meaning and value from artistic expression that integrates the intuitive dimensions of participation in the arts with broader social, cultural and theoretical frameworks.

Semester I

Paper I: (Introduction to Geology)

Course Outcomes (COs)

1) Identify and describe various physical processes and understand branches of geology
2) Compare various domains of geological science.
3) Outline application of different terminologies of geological science.
4) Categorize applications and economic importance of geological science.
5) Justify selection of geological science to utilize in social benefit of human kind interms of wealth and culture.
6) Create a base to understand geological hazards and cope-up policy.

Program Specific Outcomes (PSOs)

(i) Understand fundamental concepts, principles and processes underlying the field of Geology, its different subfields and its linkage with related disciplinary areas/subjects

(ii) Demonstrate an understanding of a wide range of geological processes (e.g. genesis of rocks and formation of geological structures, formation of minerals and their alteration.)

(iii) Undertake field tour in any part of India with respect to lithology, structure and stratigraphy and produce geological maps

Unit I

Definition of Geology branches of geology and relation to other sciences: Physical geology Structural geology, Tectonic (Dynamic) geology, Mineralagy, Petrology, Historical geology, Palentology, Economic geology, Applied geology, Geophysics, Geochemistry, hydrogeology etc. Earth as a member of solar system. Gross features of the Earth. Brief idea about core, mantle, crust, hydrosphere, atmosphere, biosphere and elemental abundance in each constituent.

Unit II

Convection in Earths' core and production of its magnetic field. Causes of Earthquakes, classification of earthquakes based on depth, propagation of earthquake waves, measurement of earthquake intensity, seismograms and seisographs, distribution of earthquakes and seismic belts. Volcanoes, types of volcanoes: active, dormant, extinct, explosive, effusive and mixed volcanoes. Types of volcanic eruptions

Unit III

Origin of Earth, Different methods of age determination: physical, geophysical, biological, astronomical, chemical. Radiometric methods of determination of age of Earth, Internal structure and chemical composition of various layers. Application of geophysics in understanding dynamics of the earth.

Unit IV

Concept and theory of Isostasy. Palaeoclimates: Indicators, glacial periods- causes of glacial ages and glacial eustasy. Continental drift: continental matching, matching geology, past galciations, ancient plants and animals, polar wandering curves.

Books
Recommended:

1) Arthur Holmes (1978) Principles of Physical Geology
2) Emmons, Thiel, Staffer and Allison: Geology principles and Processes.
3) Gilluly,Water and Woodword: Principles of Geology
4) Robinson, E.S.(1982): Basic Physical Geology
5) Judson,Deffeyws and Hargrave,R.: Physical Geology.
6) Sanders J.E., Anderson Jr., A.Z., Carola: Physical Geology.
7) Cazen, Hatcher and Siemekowski: Physical Geology
8) Borges, Gwalani and Veena Rao: Fundamentals of Geology.
9) Patwardhan A.M.: The Dynamic Earth System.
10) Howell: Introduction to Geophysics.
11) Hamblin, Kenneth: The Earths' Dynamic System.
12) Sawkins, Chase, Darby and Rapp: The Evolving Earth: A Text Book in Physical Geology.
13) Mallory and Cargo: Physical Geology.
14) Judson Kauffman and Leet: Physical Geology.
15) Skinner and Porter: The Dynamic Earth: An introduction to Physical Geology.
16) Tarbuck and Lutgens: The Earth: An introduction to Physical Geology.
17) Manroe and Wicander: Physical Geology: Exploring the Earth

Practicals:

Study and preparation of charts, Preparation of bar graphs, seismographic divisions, distribution of continents at different time frames.

Paper II (Mineralogy)

Course Outcomes (COs)

1) Identify and describe various physical properties of megascopic specimens and optical properties of minerals under microscope.
2) Compare various crystals based on symmetry, symmetry functions and explain crystal system, mineral groups based on physical and optical properties.
3) Outline application of different micro analytical tools used in mineral analysis.
4) Categorize industrial applications and economic importance of various minerals.
5) Justify selection of microanalytical technique selected for the mineral analysis.
6) Prepare a report on a mineral sample by performing the necessary tests and suggest its applications in various fields.

Program Specific Outcomes (PSOs)

(i) Understand fundamental concepts, principles and processes of mineral forming processes and its linkage with related disciplinary areas/subjects
(ii) Demonstrate an understanding of a wide range of rock forming minerals.
(iii) Undertake the chemical compositions of various minerals, categorized as silicate mineral types.

Unit I

Chemical bonding and compound formation. Mineral composition of the earth's crust. Chemistry of minerals (Polymorphism, Isomorphism and Pseudomorphism). Various physical properties of the minerals.

Unit II

Properties dependent on magnetism, electricity and radioactivity. Silicate structures. Rock forming minerals- silicates, oxides and sulphides. Chemical and physical properties and geological occurrences of the following mineral groups: olivine, garnet and aluminous silicates.

Unit III

Chemical and physical properties and geological occurrences of the following rock forming mineral groups: quartz, feldspar, feldpathoids and zeolites.

Unit IV

Chemical and physical properties and geological occurrences of the following mineral groups: pyroxenes, amphiboles and micas.

Books Recommended:

1) Read : Rutley's Elements of Mineralogy.
2) Berry, Mason and Dietrich : Mineralogy
3) Dana and Ford: A Text book of Mineralogy
4) Deer, Howie and Zussman: An introduction to rock forming minerals.

Practicals :

Study of physical properties in hand specimen of the following minerals:
Quartz and its varieties, orthoclase, microcline, albite, labradorite, nepheline, leucite, sodalite, natrolite, stilbite, apophyllite, muscovite, biotite, chlorite, hypersthene, augite, diopside, hornblende, tremolite, actinolite, asbestos, olivine, garnet, kyanite, sillimanite, topaz, staurolite, tourmaline, epidote, serpentine, talc, rhodonite, rhodochrosite, aragonite, calcite, dolomite, magnesite, barite, gypsum, apatite, beryl, fluorite, corundum, kaolinite, zircon and halite.

SEMESTER- I

VSC: Geological Mapping Techniques (BVS1P01)

Practical:

Study and preparation of thematic maps (world, India) - Maps of India - political maps, physical map, rainfall trends, wind maps, drainage maps, soil and land-use maps, mineral deposits, food – crop maps, irrigation maps, agro-climatic zone maps, road and inland maps, railway maps, population maps, natural hazard maps

Books Recommended:

1) Macmillan Publishers India Private Limited (2021)
2) Survey of India toposheets
3) Compton, R.R. (1962) Manual of Field Geology, John Wiley and Sons, Inc.
4) Forrester, J.D. (1957) Principles of Field Geology and Mining Geology, John Wiley.
5) Lahi, F.H. (1987) Field Geology, CBS Publishers.
6) Mathur, S.M. (2001) Guide to Field Geology, Prentice-Hall, New Delhi

B.Sc. SEMESTER – I

BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES:

At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
C. Components of Environment: Atmosphere (Structure and composition),hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto-cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)
B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.
C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr

P.U. Meshram, Allied Publishers, New Delhi.

8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher ,Bikaner,1994

Indian Knowledge System (IKS)

SEM1: VEDIC MATHEMATICS (BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i)Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	**8**
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhwajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	**8**
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	**7**
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	**7**
	TOTAL	**30 HRS**

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, Motilal Banarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution of Civil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5,3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

Geology Semester II

Paper I: (Physical Geology and General Geology)

Unit I

Rock weathering and erosion. Geological work done by wind and river.

Unit II

Geological work done by underground water, glaciers and oceans. Brief idea about soil. formation and types of soil.

Unit III

Earth movements: Diastrophism (Orogeny and epeirogeny). Definition and types of geosynclines. Mountain building process and types of mountains. Evolution of continents and oceans.

Unit IV

Evolution of unified theory of plate tectonics. Nature and types of plate margins, sea-floor spreading. Origin and significance of mid-oceanic ridges and trenches; origin and distribution of island arcs.

Books Recommended:

1. Arthur Holmes (1978) Principles of Physical Geology
2. Emmons, Thiel, Staffer and Allison: Geology principles and Processes.
3. Gilluly,Water and Woodword: Principles of Geology
4. Robinson, E.S.(1982): Basic Physical Geology
5. Judson, Deffeyws and Hargrave, R.: Physical Geology.
6. Sanders J.E., Anderson Jr., A.Z., Carola: Physical Geology.
7. Cazen, Hatcher and Siemekowski : Physical Geology
8. Borges, Gwalani and Veena Rao: Fundamentals of Geology.
9. Patwardhan A.M.: The Dynamic Earth System.
10. Howell : Introduction to Geophysics.
11. Hamblin, Kenneth: The Earths' Dynamic System.
12. Sawkins, Chase, Darby and Rapp: The Evolving Earth: A Text Book in Physical Geology.
13. Mallory and Cargo: Physical Geology.
14. Judson Kauffman and Leet: Physical Geology.
15. Skinner and Porter: The Dynamic Earth: An introduction to Physical Geology.
16. Tarbuck and Lutgens: The Earth: An introduction to Physical Geology.
17. Manroe and Wicander: Physical Geology: Exploring the Earth

Paper II: (Optical Mineralogy and Crystallography)

Unit I

Petrological microscope: its parts and functioning. Elementary ideas about mineral optics.Critical angle, refractive index, determination of refractive index by i) Becke line method and ii) Abbe refractometer. Twinkling, birefringence, pleochroism, interference colours, extinction and extinction angle, twinning, isotropism and anisotropism. Phenomenon of double- refraction and nicol prism.

Unit II

Optical characters of the following rock forming minerals in ordinary and plane polarized light: Quartz, microcline, orthoclase, albite, labradorite, muscovite, biotite, chlorite, hornblende, hypersthene, augite, olivine, garnet, calcite, kyanite, sillimanite, tourmaline, epidote, tremolite and actinolite.

Unit III

Laws of Crystallography, constancy of interfacial angle, rationality of indices and symmetry. Elementary ideas about crystal structure, crystal faces, edges, solid angles and zone. Crystallographic axes and axial angles. Crystal notations, Miller's indices and WeissParameters. Crystal systems and classification of crystals into six systems. Study of Galena and Zircon class of symmetry.

Unit IV

Crystal symmetry. Study of Beryl, Barytes, Gypsum and Axinite classes of symmetry.

Books Recommended:

1. Read : Rutley's Elements of Mineralogy.
2. Berry, Mason and Dietrich : Mineralogy
3. Dana and Ford: A Text book of Mineralogy
4. Deer, Howie and Zussman: An introduction to rock forming minerals.
5. Smith: Minerals and Microscopes.
6. Roger and Kerr: Optical mineralogy

Practicals:

Study of optical characters of minerals listed for theory course using polarizing microscope.Study of elements of symmetry and description of various forms of crystals from normal classes of six crystal systems.

SEMESTER- II

VSC: Evaluation to Landforms (BVS2P03)

Practical:

Preparation of charts for atmosphere; hydrosphere; biosphere; plotting of major mountain chain of World and in India; plotting of drainage orders and major rivers of India; plotting of major rivers on World map; plotting of deserts on World map.

Recommended Books

1) Arthur Holmes (1978) Principles of Physical Geology
2) Emmons, Thiel, Staffer and Allison: Geology principles and Processes.
3) Hamblin, Kenneth: The Earths' Dynamic System.
4) Sawkins, Chase, Darby and Rapp: The Evolving Earth: A Text Book in Physical Geology.
5) Mallory and Cargo: Physical Geology.
6) Judson Kauffman and Leet: Physical Geology.
7) Skinner and Porter: The Dynamic Earth: An introduction to Physical Geology.
8) Tarbuck and Lutgens: The Earth: An introduction to Physical Geology.
9) Manroe and Wicander: Physical Geology: Exploring the Earth

SEM 2 : CONSTITUION OF INDIA (BVE2T02)

Syllabus

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity

- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

Indian Knowledge System (IKS)

SEM2: INDIAN ASTRONOMY (BIK2T02)

Course Outcomes: This course will enable the students to understand that

1. It is possible to create a map of the intellectual growth of a culture usingastronomy as a probe.
2. The growth of Indian astronomy occurs in distinct stages analogous to phasetransitions of the evolution of cultures
3. Indian Astronomy therefore provides an excellent window to the pastdramatic transitions.

UNITS	TOPICS	HOURS
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	**8**
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	**8**
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	**7**
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	**7**
	TOTAL	**30 HRS**

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao.Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan,Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India, https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin% 20of%20Astronomy.pdf